BEFORE THE

Federal Communications Commission

WASHINGTON, D.C. 20554

In The Matter of	)	
	)	
Amendment of Section 2.106 of the Commission's Rules to Allocate Spectrum at 2 GHz for Use by the Mobile-Satellite Service	)	**ET Docket No. 95-18**

To: The Commission

SUPPLEMENTAL COMMENTS OF THE AMERICAN PETROLEUM INSTITUTE

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Its Attorneys

Dated: May 17, 1996

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SUMMARY

API urges the Commission to reconsider its proposal to reallocate the 2165-2200 MHz band for Mobile Satellite Service ("MSS") providers in light of the apparent lack of consumer demand for MSS service. For example, COMSAT alleges that it would not offer MSS service in this band if forced to pay the costs of relocation. Clearly, based on COMSAT's position, insufficient capital and a lack of consumer demand for yet another mobile communications service have rendered the Commission's proposal superfluous.

Should the Commission determine to reallocate this band for MSS nonetheless, then API urges the Commission to adhere to the plan it put forth in its Notice of Proposed Rule Making. Specifically, the Commission proposed to require MSS providers to relocate incumbents to comparable facilities and to fully reimburse incumbents for the costs of that relocation. API submits that sharing between Fixed Service ("FS") users and MSS providers is not feasible, and that even if sharing were feasible, it would only provide a short term remedy, not a permanent cure for interference problems between MSS and FS. Only reimbursed relocation of incumbents would provide such a permanent solution.

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SUPPLEMENTAL COMMENTS OF THE AMERICAN PETROLEUM INSTITUTE

The American Petroleum Institute ("API"), by its attorneys and pursuant to Section 1.415(d) of the Rules and Regulations of the Federal Communications Commission ("Commission" or "FCC"), hereby respectfully submits these Supplemental Comments in the above-captioned proceeding.[1/]

1. API previously filed Comments and Reply Comments in this matter. In addition, on April 5, 1996, API filed a Response ("Response") to the Supplemental Comments of COMSAT Corporation. In that Response, API expressed its opposition to COMSAT's attempt to distort the results of the 1995 World Radiocommunications Conference ("WRC-95") regarding the concept of users in the fixed microwave service ("FS") sharing the 2.1 GHz band with the Mobile Satellite Service ("MSS").

[1/] Notice of Proposed Rule Making, ET Docket No. 95-18, 10 FCC Rcd 3230, 60 Fed. Reg. 11644 (March 2, 1995).

sharing the 2.1 GHz band with the Mobile Satellite Service ("MSS").

2. Since the filing of API's Response, the Commission has placed COMSAT's Supplemental Comments on public notice and permitted parties 30 days in which to submit their views on the issues raised in COMSAT's filing. API's position explained in its Comments, Reply Comments, and Response remains unchanged. However, due to the intervening events since API's Response was filed, including the Commission's invitation for additional comments, the Commission is respectfully requested to accept these brief Supplemental Comments so that API's position on these issues is available in a contemporaneous and complete fashion.

COMMENTS

A. Fixed Services Users Face a Critical Lack of Spectrum

3. API urges the Commission to reconsider its proposal to reallocate the 2165 - 2200 MHz ("2.1 Ghz band") from FS to MSS users. As API and others explained in this proceeding, there is inadequate spectrum available for relocation of FS users. The bands which were designated for FS relocation by the Commission in its Emerging Technologies proceeding, ET Docket No. 92-9, are the 6, 11 and 18 GHz

bands. Since the conclusion of the Emerging Technologies proceeding, however, those bands have become increasingly *unavailable for use by FS.* For example, the upper 6 GHz and 18 GHz bands were reallocated at WRC-95 so that FS users are co-primary with non-geostationary ("NGSO") MSS feeder links. Moreover, spectrum reallocated from the federal government to private sector use in the 4660-4685 MHz band, in WT Docket No. 94-32, is not available to private operators, such as FS users, because licensees must meet subscriber build-out requirements and compete at auction. FS users are not commercial providers, so they are foreclosed from that spectrum. As TIA points out, other FCC proceedings have restricted FS use of the 23 GHz and 26 GHz bands in favor of Intersatellite Link and Data Relay Satellite Services. The 28 GHz band is proposed for use by Fixed Satellite Services and MSS feederlinks, rather than FS, in CC Docket 92-297. On May 7, 1996, the FCC released its orbital assignment plan for geostationary satellite systems which will operate in the Ka-band (17.7-20.2/27.5-30.0 GHz).

4. Combined with this critical shortage of FS relocation spectrum is the likelihood that insufficient consumer demand exists to support MSS in the 2.1 GHz band. Already, there are several communications satellite systems operating or planned for operation in the near future in

other portions of the spectrum. For example, in June 1995, AMSC launched its first satellite and began providing telephone service in January 1996. DBS providers can now offer such non-video services as meter reading and other data transmission services and two more DBS licenses were recently auctioned. The Commission is in the final stage of licensing the first three Big LEO providers in the 1.6 GHz band, and an additional two Big LEO providers will offer service in the next tier of licensing. Finally, on May 7, 1996, the Commission authorized the submission of coordination and notification information to the International Telecommunications Union for *seventy-four commercial geostationary satellite networks*.

5. In addition to the increasingly saturated satellite communications market, numerous terrestrial providers of mobile voice and data services have been licensed in the sixteen months since the Commission released its Notice in this proceeding. There are thousands of new licensees ready to offer service in PCS blocks A, B and C; on 900 MHz SMR frequencies; and on MDS channels. Auctions to award licenses in the upper 200 channel block of the 800 MHz SMR service, as well as the D, E and F PCS blocks, loom on the near horizon. Cellular subscribership continues to soar. With all this competition in the marketplace for

Commercial Radio Communication Services ("CMRS"), API doubts that an MSS provider, with its high start-up costs and high monthly subscriber fee, is needed or even commercially viable at this point in time. API therefore urges the Commission to refrain from reallocating the 2.1 GHz band to the MSS industry unless and until the MSS industry provides reliable data that consumer demand exists for yet another provider of CMRS.

6. The continual erosion of FS spectrum is bad for FS users' underlying business and ultimately injures the infrastructure of the United States. Should the Commission determine that MSS providers truly need additional spectrum, then API urges the FCC to utilize the great quantities of spectrum which are to be reallocated from the federal government to the private sector in the coming months and years. On March 22, 1996, the FCC released its Plan for Reallocated Spectrum ("Spectrum Plan"). This Spectrum Plan outlines the scope and timing of future FCC rule making proceedings required to reallocate 185 MHz of spectrum from federal government use to private sector use. According to its Spectrum Plan, the FCC will begin rule making proceedings later this year to reallocate and establish service in 70 MHz of this spectrum. If needed, API urges the Commission to allocate spectrum for MSS from the

available 185 MHz rather than the highly encumbered 2.1 GHz band.

B. Results of the COMSAT Conference

7. On April 25, 1996, counsel for API attended a conference held at COMSAT headquarters for the purpose of discussing the feasibility of FS and MSS sharing of the 2.1 GHz band. The conference was well-attended by members of the FCC's staff, the satellite industry, fixed services users, and equipment manufacturers ("the Group"). Many representatives of the FS industry exchanged communications prior to the meeting in an attempt to establish the framework for the session and to answer some of COMSAT's questions in advance. Attached as Exhibit A is a submission from those FS representatives to COMSAT. Exhibit B provides a list of attendees at the COMSAT conference.

8. During the conference, COMSAT demonstrated sharing software which was developed by a British company and is based on international interference calculations. Bill Rummler of AT&T and Alex Latker of the FCC both pointed out that those international criteria are simply proposals, they are not accepted formulas for studying sharing between MSS and FS in the 2.1 GHz band.

9. API's counsel pointed out that the key criteria must be United States interference criteria, since incumbents are U.S.-licensees, the band is heavily encumbered in the U.S., and domestic interference criteria are stricter than international criteria. API's counsel also noted that COMSAT ignores the fact that new studies concerning sharing between the MSS and FS in the 2.1 GHz band are required by WRC-95 documents, including Recommendation 717, in preparation for WRC-97.

10. The Group agreed that further work should be performed on this issue and determined to delegate responsibility for studying the feasibility of MSS/FS sharing to the TIA Bulletin 10 Satellite Committee, also known as TIA TR14.11. Phil Salas, a member of that Bulletin 10 Satellite Committee, agreed to direct this effort. In this way, API believes, the sharing criteria will be based on domestic uses of the 2.1 GHz band and will utilize mutually acceptable engineering standards, rather than international standards developed primarily by MSS proponents and with other countries in mind.

11. If the Commission determines to explore the feasibility of sharing the 2.1 GHz band, then API urges the agency to adopt the Group consensus and permit TIA to

develop criteria for studying sharing. API also urges the FCC to require MSS licensees to relocate and fully reimburse incumbents where sharing is not feasible.

12. API remains doubtful that any sharing study can sufficiently demonstrate that harmful interference will not result from the operation of MSS and FS in the same frequency band. API members cannot tolerate any harmful interference in light of their responsibility to meet Department of Transportation safety criteria, to ensure the public safety, to protect the environment, and to avoid ruinous liability for accidents caused by harmful interference to the operation of their microwave systems.

13. Nonetheless, if the Commission disagrees with API's position and determines to explore whether sharing is theoretically possible between MSS and FS, then API strongly encourages the FCC to examine this issue in a scientific manner through the open forum provided by TIA's Bulletin 10 Satellite Committee. API believes that the public safety responsibilities of the pipeline, railroad, electric and gas utilities, refinery, and other users of the 2.1 GHz band cannot be relegated to those unfamiliar with U.S. activities in this band or to others with an understandable bias. The United States is a highly developed nation with a sound

infrastructure built on the premise of protection of public safety and the environment. Unfortunately, not all countries in the world share our priorities or use the 2.1 GHz band in the same manner. Likewise, most commercial providers of communications services do not bear the public safety and environmental responsibilities that private users in the 2.1 GHz band must meet every minute of every day. If the feasibility of sharing this spectrum is considered by the Commission to be worthy of study, then API is confident that TIA is the best forum for resolving these issues.

14. Although it has been the predominant focus of discussion by the many participants in this proceeding, the issue of interference from MSS into FS is only one half of the problem. An even greater potential for interference exists from FS into MSS. Curiously, MSS proponents are silent on this issue. Participants at the COMSAT conference agreed that it is important to study both aspects of the sharing problem. API believes that interference from FS into MSS would be so great as to diminish any potential benefits to the MSS industry from their sharing plan. API urges the Commission to refrain from crafting rules which would punish FS incumbents for the fact that their systems pose a significant interference threat to any and all potential MSS handheld units operating in the 2.1 GHz band.

Moreover, API requests the Commission to scrutinize both aspects of the sharing problem, not just MSS into FS interference.

C. <u>Sharing: Toward What End?</u>

15. Even if sharing were somehow shown to be feasible in the 2.1 GHz band, API emphasizes that even COMSAT and the international community recognize that FS users will inevitably have to be relocated in order for MSS to operate in the medium- and long-term. Thus, sharing would, at best, be a short-term solution.

16. API believes the Commission should ask proponents of sharing: even if sharing were feasible, in light of the fact that it is a temporary solution, what worthwhile objective would be served by short-term sharing of the 2.1 GHz band? Sharing might buy the MSS industry a little time to raise revenues for relocation. Or sharing might allow such a long delay and repeated instances of interference that incumbents are ultimately forced to self-relocate without reimbursement. Either way, sharing only postpones the fact that relocation will occur and someone will have to pay for it.

17. API believes the Commission proposed the proper course in its Notice: rather than postpone the inevitable relocation, if the FCC determine's MSS needs the 2.1 GHz band, then the Commission should adhere to its plan to relocate incumbents within three years with the costs borne by MSS providers. In this way, the Commission need only apply its existing Emerging Technologies rules for voluntary and involuntary negotiation periods and reimbursement for relocation.

18. If, as COMSAT says, COMSAT is unable to pay the required relocation costs, then API submits that many other satellite companies, such as TRW, Iridium, Constellation, AMSC, Celsat and others, will fight for the right to become an MSS licensee and relocate incumbents. In an age of $10 billion auctions for small business PCS licensees, a $3 billion price tag (which is probably overinflated) would still be a bargain sale for the ability to provide nationwide (and even worldwide) MSS service.

CONCLUSION

API doubts that sufficient demand exists for MSS to justify the significant disruption caused to FS users by the Commission's proposal. Should the Commission determine that MSS does need additional spectrum, the 185 MHz of reallocated government spectrum is better suited to MSS needs.

If the Commission decides to reallocate the 2.1 GHz band nonetheless, API requests the Commission to implement its plan for reallocation of FS users with full reimbursement by MSS providers. API believes the Commission correctly concluded in its Notice that sharing the 2.1 GHz band is not feasible. API submits that the Commission need not examine this issue any further because of the temporary nature of any sharing solution and the inherent threat to public safety and the environment posed by the theory of sharing. Should the Commission wish to examine this issue further, however, API encourages the Commission to authorize TIA to study the interference problems.

WHEREFORE, THE PREMISES CONSIDERED, the American Petroleum Institute respectfully submits the foregoing Comments and requests the Federal Communications Commission take action in a manner consistent with the views expressed herein.

Respectfully submitted,

AMERICAN PETROLEUM INSTITUTE

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Dated: May 17, 1996

EXHIBIT A

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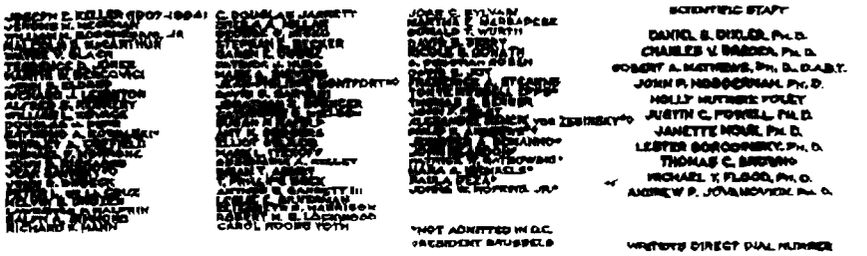

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WRITER'S DIRECT DIAL NUMBER

April 24, 1996

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VIA FACSIMILE

Re: FCC ET Docket No. 95-18;
Amendment of Section 2.106 of the
Commission's Rules to Allocate
Spectrum at 2.1 GHz for Use
by the Mobile Satellite Service
COMSAT Computer Simulation Meeting

Dear Nancy:

In order to facilitate the upcoming meeting at your offices concerning COMSAT's computer simulation software, a group of Fixed Services ("FS") users convened a series of conference calls during the weeks of April 15 and April 22, 1996. The following persons participated in one or more of those conference calls:

- Rick Smith of Texaco, Inc.
- Sean Stokes and Dennis Guard of UTC, the Telecommunications Association
- George Kizer, Bill Knight and Phil Salas of Alcatel Network Systems
- Denis Couillard of Harris Farinon
- Thu Nguyen of Radio Dynamics, Inc.
- Bill Rummler of AT&T
- Thomas Keller on behalf of the Association of American Railroads
- John Reardon on behalf of the American Petroleum Institute

The participants discussed their general concern that they have received insufficient information concerning the nature of

COMSAT's proposed ICO system and the equations to be used in COMSAT's computer simulation software. On several occasions, for example, I have requested from Jeff Binckes, Ray Crowell and Sam Nguyen a copy of COMSAT's software so that FS users could study it ahead of time. Unfortunately, I have not yet received that software.

The group also identified specific information which it felt the FS community would need in order to intelligently study the issue of sharing between the FS and Mobile Satellite Services ("MSS") in the band 2165-2200 MHz ("the 2.1 GHz band"). Provided herewith is a list of preliminary questions; these questions are designed to shape the dialogue at Thursday's meeting by providing COMSAT with guidance concerning the need of FS users for more complete information. FS users hope that these questions will provide some guidance explaining such basic issues as the parameters of COMSAT's planned system and the specific equations and assumptions which underly the computer simulation software.

Also provided herewith is a partial list of answers to questions which COMSAT posed to FS users and a letter from George Kizer of Alcatel Network Systems. As you will see, many of COMSAT's questions are answered, but in order to answer most of the questions completely, the participants felt obliged to know the operating characteristics of the ICO system, as well as the equations and assumptions underlying COMSAT's software. For example, the participants were hesitant to characterize an average FS system because they want to avoid a situation where the average scenario becomes the standard. Instead of the average scenario, FS users are highly concerned with the worst case scenario.

FS users such as utilities, railroads, pipelines and refineries cannot afford to conduct business based on the laws of probability and averages: they must ensure the public safety and protect the environment. They cannot tolerate even one instance of harmful interference. Thus, the participants from the FS community find statistical averages largely irrelevant; the bottom line for protection of public safety is not the average scenario of harmful interference, but the worst-case scenario of harmful interference.

PRELIMINARY QUESTIONS:

- What equations are used in the simulation program?
- How do these equations differ from and comport with the WRC-95 Final Acts?

- Please provide what COMSAT believes to be the worst case satellite alignment/transmission scenarios that would impact the FS users:

  - Have you considered multiple MSS system interaction with multiple satellites systems and various multiple access techniques?

  - What multiple access technique is planned for use with COMSAT's MSS?

  - How will the situation evolve as MSS loading increases?

- What FS unfaded RSL is being modeled in the simulations?

- FS users are concerned that certain ITU documents refer to "studies" but do not include cites to the specific studies; please provide actual copies (not cites) of any and all scientific studies which have addressed the issue of MSS/FS sharing below 3 GHz and upon which COMSAT relies.

PRELIMINARY ANSWERS:

- Many existing FS systems have unfaded RSL's of -50dbm. This still allows for fade margins around 40 db because of the sensitive receiver thresholds which are common in the 2130-2150 MHz and 2180-2200 MHz band.

- An FS antenna is typically Type B per Section 94.75 of the FCC's Rules.

- The typical antenna at 2.1 GHz is a 6 foot parabolic dish, with gain of approximately 29.5db, and between 5-8 degree, 3 dB beamwidth.

- Modulation = Analog FDM/FM 48 channel 800 kHz

- Modulation = Digital 256 QAM

- Transmit Power = 1-2 watts = 30-33 dBm

- Polarization = Worst Case

- Height of terrain at station = Worst Case

- Propagation Model = Barnett Vigants from TIA Bulletin 10-C

* * * *

I hope this information is helpful and look forward to discussing these issues further at the meeting on Thursday. In the meantime, should you have any questions, please let us know.

Cordially yours,

John Reardon

Enclosure

cc: Charles Iseman
Alex Latker
Sean White
Sam Nguyen
Jeff Binckes
Ray Crowell
Rick Smith
Sean Stokes
Dennis Guard
George Kizer
Bill Knight
Phil Salas
Denis Couillard
Thu Nguyen
Bill Rummler
Thomas Keller

NETWORK SYSTEMS

MEMORANDUM

To John Reardon c.c.

From George Kizer

Date April 23, 1996

Ref Today's Conference Call Regarding COMSAT Technical Data Request

The following is my input for consolidation in your response to Sam Nguyen of COMSAT:

1. The following are typical characteristics of fixed point to point radio systems operating in the approximately 2.2 GHz band in the United States (Consideration should be given to Canadian systems which have other characteristics such as transmission bandwidths as wide as 29 MHz.):

a. Analog Systems

Operational Bandwidth:	800 kHz
Modulation Type:	48 Channel FDM-FM
Transmitter Power:	2 Watts, Constant Power
Nominal Received Signal Level (RSL):	-50 dBm
RSL at 30 dB S/N Threshold:	-92 dBm
Receiver Noise Figure (Temperature):	6 dB (1155 ^{0}K)

b. Digital Systems

Operational Bandwidth:	3.5 MHz
Modulation Type:	4 DS-1, 256 or 64 QAM
Transmitter Power:	1 Watt, up to 10 dB ATPC
Nominal Received Signal Level (RSL):	-30 or -40 dBm
RSL at 10^{-6} BER Threshold:	-73 or -83 dBm
Receiver Noise Figure (Temperature):	4 dB (728 ^{0}K)
Transmitter T/I:	39 or 33 dB

c. Receiver Filter Characteristics

N/A - interference is co-channel, desired signal occupies entire transmission bandwidth (allocated bandwidth and occupied bandwidth are the same)

d. Typical Antennas

Type:	Parabolic
Polarization:	Linear, Horizontal and/or Vertical
Elevation Angle:	$+1^{\circ}$ to -1°
Azimuth:	Any
Height:	0 to 1.5 miles AMSL
Feeder Loss:	0 dB
Typical Sizes:	6 or 8 Feet
Main Beam (Peak) Gain:	29 to 32 dB (See Attachment, Table 11-2)
Side Lobe Suppression:	Per Attachment, FCC Antenna Standards, 1,850 to 2,500 MHz, Category B (Assume 0 dB for 0° to 5°)

e. Link Type

Bi-directional
Full period duplex
Any location in the United States
Path link typically 30 miles

f. Performance Estimation Methodology

Performance Objectives
Bulletin 10F, Para. 4.2.2. attached

Fading Model
Bulletin 10F, Para. 4.2.3 (ATT/Bell Labs Barnett-Vigants Model), attached
NOTE: ITU-R Rec. 530 is not recognized by the North American fixed point-to-point microwave industry

Interference Criteria
For constant power and frequency interference use I/N and C/(N+I) methods as described in Bulletin 10F, Paras. 2.5.4, 2.5.5 and A-6, attached.
For other systems, specific methods must be determined.

2. The main objective of the meeting later this week in Washington is to discuss sharing of fixed microwave frequencies with the mobile satellite service. The exact characteristics of the mobile satellite systems are not well defined to the fixed microwave community. We have heard some indication that the mobile satellite system designers anticipate changing satellite and/or earth station power and/or frequencies.

All current industry accepted methods of estimating interference effects into fixed microwave radio systems assume constant power and frequency interfering signals. If the mobile satellite systems will vary power and/or frequency, the first issue to resolve is an appropriate method of estimating interference into fixed microwave systems.

Interference effects into analog radios are well characterized by average interference power. On the other hand, interference effects into digital radios are characterized by peak interference power (This is not universally understood since most practical interference cases are not time varying.). As long as the interference is not time varying, the peak interference power to average desired carrier power is typically converted to an average interfering power to average desired carrier power for convenience. Digital radio interference analysis based upon average interference power will lead to unreliable results if the interference power is time varying. The worst case errors occur when the interference is the strongest (assuming time constant statistical characterization of the interference).

In addition to the above interference considerations, interfering systems with large peak to average power ratios can create a nonlinear interference effect. High peak to average interference power can cause the radios to loose carrier lock and radio frame for low average interference power. The radio clock recovery and resynchronization time and the actual methods of performance tabulation (e.g., errored-seconds, degraded minutes) must then be considered in addition to the "theoretical" interference induced error performance.

A full understanding of the interference environment is necessary to allow us the be sure our analysis methodology is appropriate.

Best regards,

George Kizer

code of federal regulations

Telecommunication

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PART 80 TO END

Revised as of October 1, 1994

CONTAINING
A CODIFICATION OF DOCUMENTS
OF GENERAL APPLICABILITY
AND FUTURE EFFECT

AS OF OCTOBER 1, 1994

With Ancillaries

Published by
the Office of the Federal Register
National Archives and Records
Administration

as a Special Edition of
the Federal Register

ANTENNA STANDARDS

Frequency (MHz)	Category	Maximum beam width to 3 dB points (included angle in degrees)	Minimum antenna gain (dBi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibles						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
932.5 to 935	A	14.0	N/A	....	6	11	14	17	20	24
941.5 to 944	B	20.0	N/A	....	....	6	10	13	15	20
952 to 960 [14]	A	14.0	N/A	....	6	11	14	17	20	24
	B	20.0	N/A	....	....	6	10	13	15	20
1,850 to 2,500 [2]	A	8.0	N/A	12	18	22	25	29	33	39
	B	8.0	N/A	5	18	20	20	25	28	38
3,700 to 4,200	A	N/A	36	23	29	33	36	42	56	55
	B	N/A	36	20	24	28	32	32	32	32
5,925 to 6,875 [10]	A	N/A	38	25	29	33	36	42	55	55
	B	N/A	38	20	24	28	32	35	36	36
6,525 to 6,875 [11]	A	1.5	N/A	26	29	32	34	38	41	49
	B	2.0	N/A	21	25	29	32	35	39	45
10,550 to 10,680 [3 9]	A	3.4	34	20	24	28	32	35	55	55
	B	3.4	34	20	24	28	32	35	35	39
10,565 to 10,615 [3 12]	N/A	360	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10,630 to 10,680	N/A	N/A	34	20	24	28	32	35	36	36
10,700 to 11,700 [10]	A	N/A	38	25	29	33	36	42	55	55
	B	N/A	38	20	24	28	32	35	36	36
12,200 to 13,250 [6]	A	1.0	N/A	23	28	35	39	41	42	50
	B	2.0	N/A	20	25	28	30	32	37	47
17,700 to 19,700 [6]	A	N/A	38	25	29	33	36	42	55	55
	B	N/A	38	20	24	28	32	35	36	36
21,200 to 23,600 [6]	A	N/A	38	25	29	33	36	42	55	55
	B	N/A	38	20	24	28	32	35	36	36
31,000 to 31,300 [7 8]	N/A	4.0	38	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38,600 to 40,000	A	N/A	38	25	29	33	36	42	55	55
	B	N/A	38	20	24	28	32	35	36	36

[1] Except for frequencies listed in Sec. 94.65(a)(1), where omnidirectional antennas may be used.
[2] Except for 2,150–2,160 MHz, where the maximum beamwidth is 360 degrees.
[3] Except as provided for in paragraph (h) of this section.
[4] Antennas used at outlying stations as part of a central protection alarm system need conform to only the following 2 standards: (1) The minimum on-beam forward gain must be at least 10 dBi, and (2) the minimum front-to-back ratio must be at least 20 dB.
[5] Except as provided in §94.91.
[6] Except for temporary-fixed operations in the band 13200 MHz–13250 MHz with output powers less than 250 mW and as provided in §94.90.
[7] The minimum front-to-back ratio shall be 38 dBi.
[8] Mobile, except aeronautical mobile, stations need not comply with these standards.
[9] Except for such antennas between 140 deg. and 180 deg. authorized or pending on January 1, 1989 for which minimum radiation suppression to angle (in degrees) from centerline of main beam is 36 decibels.
[10] These antenna standards apply to all point-to-point stations authorized after June 1, 1997. Existing licensees and pending applicants on that date are grandfathered and need not comply with these standards.
[11] These antenna standards apply to all point-to-point stations authorized on or before June 1, 1997.
[12] These antenna standards apply only to Digital Termination User Stations licensed, in operation, or applied for prior to July 15, 1993.